1.0 Phase II Accreditation Support Package Description

The Phase II Accreditation Support Package (ASP II) contributes to logical verification and face validation activities by providing software design information and the results of sensitivity analyses that address model functionality. Assumptions and limitations inherent in the model design can be found in the Conceptual Model Specification in Section 2.0, and the results of exercising the functional elements (FEs) of the model over ranges of input conditions are reported in the Sensitivity Analysis results of Section 3.0. Other V&V activities that contribute to a Subject Matter Expert (SME) review in support of Phase II accreditation (input data verification and validation, comparison of model outputs with intelligence data or best estimates, and review of model assumptions, limitations and errors) are described in the *SMART VV&CM Process Description Document* [A.2-1]. The results of these, since they generally apply to a specific application, would be reported in the accreditation report for that application, and so are not included here.

1.1 Conceptual Model Specification

The purpose of logical verification is to identify and compare the model assumptions, limitations, and approximations with the phenomena being modeled to ascertain whether the conceptual model (and its resultant implementation in the code) can reasonably be expected to produce realistic results when compared with real-world phenomena. Logical verification ensures that the basic equations and algorithms comprising a model are correct within the bounds of the stated limitations, and helps to determine the appropriateness of a model for a particular application.

ASP II information contributes to logical verification efforts by providing the user with a detailed description of the model design requirements, approach, and implementation, as well as limitations, assumptions, and approximations at the FE level. This information should allow the model user to determine the range of applications for which the model can be reasonably expected to produce valid results. It remains for the user, of course, to compare this range with that required for the application at hand, and to make a determination of model suitability.

1.2 Sensitivity Analysis

The purpose of face validation is to establish the reasonableness of model outputs, given well-defined input conditions. It is typically accomplished by a team of SMEs who have detailed knowledge of real-world results of the phenomenon being modeled. SMEs review input data sources for acceptability, define input scenarios based on required applications, and analyze model outputs to assess whether they appear realistic or representative of results that might occur in the real world under the same set of conditions. Face validation is not validation in the classical sense, but it does provide a more credible and detailed stamp of approval than the mere fact that a model is widely used. While expert opinion has traditionally been the validation mode of choice, its value is contingent upon the independence and level of expertise of the reviewers, and the scope of the review itself.

Face validation includes a review of results from four V&V activities:

a. Input data verification, consisting of a review of model input data sources and consistency of definition of how the data were collected, as well as a clear definition of how the data are used in the model;

b. Input data validation, consisting of a comparison of user input and embedded data to the corresponding known (or best estimate) real-world values;

c. Comparison of model outputs with intelligence data or analyses, and/or known or best estimates of real-world values for corresponding phenomena; and

d. Functional- and/or model-level sensitivity analyses.

ASP II contributes to face validation by providing the results of detailed sensitivity analyses performed on the model and its functional elements. To complete face validation, it remains for the user to perform input data V&V, to compare model outputs with acceptable results (e.g., from intelligence sources or other models), and to review all of these with respect to model acceptability criteria that are dependent upon the intended application.

1.3 Document Organization

The Susceptibility Model Assessment and Range Test (SMART) Project has developed a unique concept for the conduct of verification and validation of engagement-level models and simulations. The SMART Project has divided radio frequency (RF) sensor models into seven functional areas: target characteristics, propagation, transmitter, receiver, antenna, signal processing, and target tracking. These functional areas have been further subdivided into functional elements as shown in the Functional Area Template of figure 1.3-1. The Functional Area Template decomposes the models into generic, identifiable functional elements (FEs) which match those of the real-world radar system, target, and environment. V&V activities are then conducted for individual FEs.

RF SENSOR FUNCTIONAL AREA TEMPLATE (FAT)

1.0 TARGET CHARACTERISTICS
- 1.1 FLIGHT PATH
- 1.2 SIGNATURE
  - 1.2.1 RCS
    - 1.2.1.1 STATIC
    - 1.2.1.2 DYNAMIC
  - 1.2.2 FLUCTUATIONS
- 1.3 ECM
  - 1.3.1 NOISE
    - 1.3.1.1 ON BOARD
    - 1.3.1.2 OFF BOARD
    - 1.3.1.3 STANDOFF
  - 1.3.2 DECEPTIVE
    - 1.3.2.1 ON BOARD
    - 1.3.2.2 OFF BOARD
    - 1.3.2.2 STANDOFF

2.0 PROPAGATION
- 2.1 MASKING
- 2.2 CLUTTER
- 2.3 MULTIPATH / DIFFRACTION
- 2.4 ATMOSPHERIC ATTENUATION

3.0 TRANSMITTER
- 3.1 WAVEFORM GENERATOR

4.0 RECEIVER
- 4.1 THERMAL NOISE
- 4.2 AGC
- 4.3 DETECTOR
- 4.4 BLANKING

5.0 ANTENNA
- 5.1 ANTENNA GAIN
- 5.2 ANTENNA SCAN

6.0 SIGNAL PROCESSING
- 6.1 THRESHOLD
- 6.2 CLUTTER REJECTION
  - 6.2.1 MTI
  - 6.2.2 DOPPLER FILTERS
- 6.3 INTEGRATION
- 6.4 PULSE COMPRESSION

7.0 TARGET TRACKING
- 7.1 ANGLE
- 7.2 RANGE
- 7.3 DOPPLER

Figure 1.3-1 RF Sensor Functional Area Template

For purposes of the ASP documentation set, a numbering scheme relating FE template numbers to document sections was required. The scheme that was adopted presents verification results in section 2 and validation results in section 3. Within each of these sections, FEs are numbered sequentially. Table 1.3-1 shows the FE numbering scheme used to document V&V efforts for RF Sensor models in ASPs II and III. In ASP II, the Conceptual Model Specification for each FE is found in section 2.*n*, while the Sensitivity Analysis of each FE is presented in section 3.*n*, where *n* is the FE's ASP FE number as given in table 1.3-1.

Table 1.3-1 FE Section Numbering in ASPs II and III

FAT FE Number	FE Name	ASP FE Number
1.1	Flight Path	1
1.2.1.1	Static Radar Cross Section	2
1.2.1.2	Dynamic Radar Cross Section	3
1.2.2	Signature Fluctuations	4
1.3.1.1	On-board Noise ECM	5
1.3.1.2	Off-board Noise ECM	6
1.3.1.3	Stand-off Noise ECM	7
1.3.2.1	On-board Deceptive ECM	8
1.3.2.2	Off-board Deceptive ECM	9
1.3.2.3	Stand-off Deceptive ECM	10
2.1	Masking	11
2.2	Clutter	12
2.3	Multipath/Diffraction	13
2.4	Atmospheric Attenuation	14
3.1	Waveform Generator	15
4.1	Thermal Noise	16
4.2	Automatic Gain Control (AGC)	17
4.3	Detector	18
4.4	Blanking	19
5.1	Antenna Gain	20
5.2	Antenna Scan	21
6.1	Threshold	22
6.2.1	Moving Target Indicator Clutter Rejection	23
6.2.2	Doppler Filters Clutter Rejection	24
6.3	Signal Integration	25
6.4	Pulse Compression	26
7.1	Angle Track	27
7.2	Range Track	28
7.3	Doppler Track	29